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ABSTRACT

This paper summarizes the research on learning style based on responses to the Learning Style Inventory by 1,836 students in grades 1 through 12. Reliability analyses are included for each sub-scale for males and females based on factors determined by factor and content analysis. The intercorrelations are included for males and females within grades 1 through 12 and a summary of the significant differences between males and females is also included. Overall, individual students have different preferences for how they learn. The preferences change at different grade levels and males and females, as a group, have different learning preferences within grades and across grades. (Author)

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Summary of Research on Learning Style based on the Learning Style Inventory

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Summary of Research on Learning Style
based on the Learning Style Inventory

Introduction

The Learning Style Inventory (LSI)[1] was developed in response to the need for identifying how students prefer to learn when provided an opportunity to choose from among environmental, sociological, and physical conditions. Specifically, it was designed for use in conjunction with several alternative approaches to individualized instruction--Contract Activity Packages (CAPs), Learning Activity Packages (LAPs), programed learning, and/or multisensory instructional packages (Dunn and Dunn, 1975). Each of these methods is a structured, complete, behaviorally stated guide to learning objectives, resources, activities, and criterion-referenced assessments related to a specific concept.

In reviewing the literature to determine how children learn it was repeatedly verified that different students learn in many different ways. The research data suggests eighteen areas that were important in identifying what effects learning. These include: a. immediate environment (sound, heat, light, and design); b. own emotionality (motivation, responsibility, persistence and structure); c. sociological needs (self, pairs, teams, peers, adults and/or varied); and d. physical needs (perceptual preferences, time of day, food intake and mobility) (Dunn and Dunn, 1974).

In an effort to secure data for teachers, the Learning Style Inventory (LSI) was designed to elicit from students information concerned with how they study and learn when provided options of doing so away from and within the school situation (Dunn, Dunn and Price, 1976, 1977). Several research studies have demonstrated that (1) students can identify their own learning styles, (2) when exposed to a teaching style consonant with the ways they believe they learn, students score higher on tests and factual knowledge, have better attitudes, and are more efficient than those taught in a manner that is dissonant with their learning style, and (3) it is advantageous to teach and test students in their preferred modalities (Domiro, 1970; Farr, 1971).

When the computer printout has been completed, each of the elements that are important to the tested individual' s learning style profile are enumerated and page references to an accompanying Manual are cited. The

[1] Information about the LSI can be obtained by writing to Price Systems, Box 3271, Lawrence, Ks. 66044.

Abstract

This paper summarizes the research on learning style based on responses to the Learning Style Inventory by 1836 students in grades 1 through 12. Reliability analyses are included for each sub-scale for males and females based on factors determined by factor and content analysis. The intercorrelations are included for males and females within grades 1 through 12 and a summary of the significant differences between males and females is also included.

Overall, individual students have different preferences for how they learn. The preferences change at different grade levels and males and females, as a group, have different learning preferences within grades and across grades.

Manual suggests both instructional strategies and resources that complement the revealed learning style elements, including alternative ideas for adapting a classroom to the specific sub-scale elements. Thus, a teacher whose students have had the LSI administered to them can develop a total prescription for each individual based on (1) the revealed learning style uniqueness of each person and (2) the alternative and/or suggested instructional methods, resources, room designs, and sociological directions for usage that are cited in the Manual.

Description of Sub-scales

The Learning Style Inventory (LSI) was designed to elicit each student's personal preferences for different elements in twenty-four areas. These are grouped according to four basic stimulants -- the environment and one's emotional, sociological, and physical learning patterns. Questions concerning each of the sub-scales are presented and selected responses tend to reveal highly personalized characteristics that, when combined, represent the way in which an individual student learns with maximum ease. The twenty-four areas include the following:

1. Sound - Quiet or Sound Preferred
2. Light - Bright or Low
3. Temperature - Cool or Warm
4. Design - Informal or Formal
5. Self-Motivated
6. Adult-Motivated
7. Teacher-Motivated
8. Unmotivated
9. Persistent or Not Persistent
10. Responsible or Not Responsible
11. Structure - Needs or Does Not Need Structure
12. Prefers Learning Alone
13. Peer Oriented Learner
14. Prefers Learning with Adults
15. Prefers Learning Through Several Ways
16. Has Auditory Preferences
17. Has Visual Preferences
18. Has Tactile and Kinesthetic Preferences
19. Food - Requires or Does Not Require Food
20. Functions Best in Morning
21. Functions Best in Late Morning
22. Functions Best in Afternoon
23. Functions Best in Evening
24. Mobility - Needs or Does Not Need Mobility

Methodology

Sample

The sample consisted of 1836 subjects (942 males, 894 females) in grades 1 - 12 tested in Kansas, Michigan, New Jersey, New York, Pennsylvania and Texas. The factor analysis was based on 1000 subjects from the above sample.

The number of males and females tested at each grade level are as follows.

Grade	Males	Females
1	11	11
2	43	51
3	114	101
4	125	127
5	105	142
6	182	205
7	47	52
8	52	47
9	64	80
10	61	48
11	47	38
12	43	80
Total	894	942

Instrumentation

The LSI has twenty-four areas and scores are reported for thirty-six sub-scales. Each sub-scale has two to seven dichotomous items based on the factor analysis (see Table 1). Each sub-scale score represents the extent to which that characteristic is preferred by the student when he/she learns or concentrates.

Statistical Procedures

This paper summarizes the results of several analyses on the Learning Style Inventory (LSI) to establish the reliability of the instrument and to identify the relationship of learning style preferences between grades and between sexes within grades.

Factor Analysis of Learning Style Inventory

The factor analysis is based on student responses to 100 items from the LSI for 1000 subjects in grades 1 through 12. The principal components with unrelated factors were the basis for the factor analysis. From this analysis 32 factors had eigenvalues greater than 1.00 and explained .615 cumulative proportion of total variance on the LSI for the 1000 subjects. The total is the sum of the diagonal elements of the correlation (covariance) matrix and the variance explained by each factor is the eigenvalue for that factor.

Each factor explains the variance based on how the 1000 subjects responded to the 100 items on the LSI. When items load on a single factor

this indicates that the items are accounting for similar variance and that the subject' s responses indicate that there is a very close relationship among those items. This relationship is not necessarily a casual relationship but may suggest a deeper more basic structure within individuals which causes individuals to respond in a similar way to the items which loaded on a factor.

Factor Loadings Rotated

The factors and each of the items with its correlation with each factor were submitted to the BMDP4M computer program using varimax, an orthogonal rotation to maximize the variance of the squared factor loadings using Kaiser' s (1958) normalization (Rummel, 1970, p. 390). The number of iterations for the rotation were 50 and the gamma (precision) level was 1.00.

The factors were rotated to identify which factors were orthogonal and to minimize cross loadings (items loading on more than one scale).

The thirty-two factors accounted for 62 percent of the total variance. The eigenvalues associated with each factor ranged from 6.44 to 1.02. No factors were selected with eigenvalues less than 1.00.

Insert Table 1 here

From this factor analysis thirty-three factors were found which corresponded to the LSI sub-scales. For each of the LSI sub-scales number 8, 15, 25 and 36 two factors were found which were independent and accounted for a unique portion of the variance. LSI sub-scale 8, requiring informal design, seems to look at two aspects of informal design based on the factor analysis. One area is liking to be able to change position and the other is having the ability to have a relaxed physical position when studying.

LSI sub-scale 15, responsible, includes two aspects, one is to keep commitments one makes to others and the other is to do what others ask one to do.

LSI sub-scale 25, has auditory preferences, includes two aspects, like to hear others talk and learning and remembering by hearing.

LSI sub-scale 36, not needing mobility, includes two aspects, being able to stay in one place for a long time and being able to stay with one' s work until it is finished.

It was decided to combine the two factors for each of the above LSI sub-scales because of the similar relationship to each in terms of learning environments.

The factor analysis also indicated the following information related to the LSI. A separate factor could not be identified for learning with two peers, learning with several peers, and having kinesthetic preferences (LSI sub-scales 21, 22, and 28 respectively). There were separate factors for learning alone, learning with one peer, learning with adults and learning through several ways. In addition learning through the kinesthetic sense could not be differentiated from tactile preferences based on questions in the LSI.

Overall, the factor analysis indicated that 33 of our 36 sub-scales were accounting for unique portions of the total variance and were able to identify independent measures of learning style based on the questions in the LSI.

There were two factors that were identified in the factor analysis that did not correspond to any sub-scale on the LSI. This was factor 18; with two items, "I do better if I know my work is going to be checked" and "The things I remember best are the things I write about;" and factor 29 with one item, "I feel wide awake after 10:00 in the morning." These items have been dropped from the computerized scoring procedure on the LSI until more research is done to indicate what these factors are measuring that is different from what the other factors are measuring.

Reliability Analysis of Areas on Learning Style Inventory

Statistical Procedures

For each LSI area for males and females in grades 1 through 12, the mean, standard deviation, reliability and standard error was calculated. The Hoyt (1941) analysis of variance procedure was used to estimate reliability for each sub-scale and is equivalent to the Kuder and Richardson (1937) formula (20) procedure. Point-biserial correlations were computed between the item score and the sub-scale to which the item contributed.

Insert Table 2 here

A summary of the reliability analysis for grades 1 through 12 includes the following. Of the 48 reliability analyses calculated, 33% were greater than .70, 25% were between .50 and .69, 23% were between .30 and .49

and 19% were less than .29 with only seven items per sub-scale, at the most. Thus, the reliabilities were generally very good considering the small number of items in each sub-scale.

Intercorrelations for Each Area on the Learning Style Inventory

The product moment correlation coefficient was computed for each of the areas on the LSI for males and females across grades 1 through 12.

When something is positively correlated this means that a high score on one scale is related to having high scores on another scale and if one achieves a high score on one of the scales he/she will also obtain a high score on the other scales if there is a positive correlation. If there is a negative correlation it means that an individual achieves a high score on one scale and probably will obtain a low score on the other scale.

A summary of the significant correlations indicate the following LSI areas are positively and/or negatively related for males.

Insert Table 3 here

Preferring quiet is positively correlated with light, learning alone, tactile and kinesthetic preferences and mobility and is negatively correlated with unmotivated, peer oriented, auditory preferences and food intake. Light is positively correlated with responsible and is negatively correlated with design and unmotivated. Cool temperature is positively correlated with peer oriented and is negatively correlated with learning alone. Informal design is negatively correlated with self-motivated, adult-motivated, teacher-motivated and persistent. Self-motivated is positively correlated with adult-motivated, teacher-motivated, persistent, responsible, learning alone and learning in the afternoon and is negatively correlated with unmotivated, learning with adults, food intake, mobility, persistent and responsible. Teacher-motivated is positively correlated with persistent, responsible, learning in several ways, auditory preferences, tactile and kinesthetic preferences and learning in the afternoon and is negatively correlated with unmotivated. Unmotivated is positively correlated with food intake, mobility and is negatively correlated with persistent, responsible, visual preferences and learning in the afternoon. Persistent is positively correlated with responsible, learning alone, learning in the afternoon and is negatively correlated with learning with

adults, food intake, learning in late morning and mobility. Responsible is positively correlated with learning in the afternoon and is negatively correlated with wanting food and having mobility. Needing structure is positively correlated with learning in several ways. Learning alone is negatively correlated with peer oriented, learning with adults, learning in several ways, visual preferences, food intake, learning in late morning and mobility. Peer oriented learning is positively correlated with learning with adults, learning in several ways, auditory preferences, tactile and kinesthetic preferences, food intake, preferring to learn in late morning and having mobility. Learning with adults is positively correlated toward learning in several ways, visual preferences, tactile and kinesthetic preferences, food intake, learning in the late morning and afternoon. Learning in several ways is positively correlated with auditory preferences, visual preferences, tactile and kinesthetic preferences, learning in morning and afternoon. Auditory preferences are positively correlated with food intake. Visual preferences are positively correlated with tactile and kinesthetic preferences and learning in the late morning and is negatively correlated with learning in the evening. Tactile and kinesthetic preferences are positively correlated with learning in the late morning and learning in the evening. Food intake is positively correlated with mobility and is negatively correlated with learning in the afternoon. Learning in the morning is positively correlated with learning in the late morning. Preferring to learn in the afternoon is negatively correlated with mobility.

A summary of the significant correlations indicate the following LSI areas are positively and/or negatively correlated for females.

Insert Table 4 here

Preferring Quiet is positively correlated with light, teacher-motivated, learning alone, learning with adults and learning in the evening, and is negatively correlated with responsible and food intake. Light is positively correlated with adult-motivated, teacher-motivated, and auditory preferences. Informal design is negatively correlated with peer oriented, food intake, and mobility. Self-motivated is positively correlated with adult-motivated, teacher-motivated, persistent, responsible, and learning in the afternoon and is

negatively correlated with unmotivated, learning with adults, food intake and mobility. Adult-motivated is positively correlated with teacher-motivated, persistent, responsible, peer oriented and is negatively correlated with unmotivated. Teacher-motivated is positively correlated with persistent, learning with adults, tactile and kinesthetic preferences and is negatively correlated with unmotivated and mobility. Unmotivated is positively correlated with food intake and mobility and is negatively correlated with persistent, responsible, learning in several ways, visual preferences, and learning in the afternoon. Persistent is positively correlated with responsible, learning alone, learning in the afternoon and is negatively correlated with learning with adults, food intake, learning in the late morning and mobility. Responsible is positively correlated with tactile and kinesthetic preferences and learning in the afternoon and is negatively correlated with food intake and mobility. Structure is positively correlated with learning with adults and learning in several ways. Learning alone is positively correlated with visual preferences and is negatively correlated with peer oriented, learning with adults, learning in several ways, food intake and mobility. Peer oriented is positively correlated with visual preferences, food intake, learning in late morning and mobility. Learning with adults is positively correlated with learning in several ways, visual preferences, tactile and kinesthetic preferences, learning in the morning, late morning, in the afternoon, and in the evening. Learning in several ways is positively correlated with tactile and kinesthetic preferences, learning in the morning and late morning. Auditory preferences is positively correlated with food intake and is negatively correlated with learning in the morning. Visual preferences is positively correlated with tactile and kinesthetic preferences, learning in the late morning and is negatively correlated with food intake, learning in the evening and mobility. Tactile and kinesthetic preferences is positively correlated with learning in the late morning and learning in the evening. Food intake is positively correlated with mobility and is negatively correlated with learning in the afternoon. Learning in the morning is positively correlated with learning in the late morning. Learning in the afternoon is negatively correlated with mobility. The above summarizes the significant correlations for the females.

Analysis of Variance Among Grades 1 through 12 for Males and Females

A oneway analysis of variance was conducted for males and females to determine if there was a significant difference among grades 1 - 12. If an overall F-value was significant for an LSI area, Scheffé post hoc procedures were used to determine which grades were significantly different from each other. Table 5 summarizes the overall significant differences for each LSI area for males and females.

Insert Table 5 here

For the forty-eight oneway analyses of variance calculated, 29 or 60% were significant at $p \leq .01$, with 19 or 40% significant at $p \leq .0001$ so the probability of these significant differences occurring due to chance is very remote. The analyses indicate that the preference for certain learning styles varies across grades for both males and females. Twenty of the twenty-four analyses were significant for females ($p \leq .05$) and 15 of the 24 analyses were significant for males. Scheffé post hoc procedures were used to determine between what grades the significant differences occurred. Even though an overall F-value was significant the conservative Scheffé procedures may not find a significant difference between any two or more grades. This discussion is going to focus on the significant differences that seem meaningful (i.e. that we can explain!) at this time in the research.

Where meaningful significant results were found, the scores were converted to a standard score scale (mean of 50, standard deviation of 10) to aid in interpretation and comparison of the results.

The following LSI areas are of interest for the males. In the area of sound the 4th grade (score of 54) was significantly different from grade 10 (score of 45). In general the lower the grade the more males wanted to concentrate or learn in a quieter environment.

The lower the grade the more male students indicated they were teacher-motivated than in higher grades. The greatest difference was between grade 2 (score of 53) and grade 12 (score of 43).

In the area of persistence, male students in grade 1 (score of 37) were significantly different, less persistent, than male students in grades 5 (score of 51), 6 (score of 51), and 12 (score of 52). There seemed to be no consistent pattern to this area across grade levels however.

Male students in the lower grades preferred learning with adults significantly more than did male students in higher grades. In fact, there is a direct relationship between the two variables. The more male students are in school the less they like to learn with adults. The scores for each grade are presented in the following chart. The higher the score means one prefers to learn with adults.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	61	57	53	52	51	48	51	51	47	46	44	44

In the area of preferring to learn through tactile and kinesthetic preferences, in general, the higher the grade the less males prefer to learn through this modality. The scores for each grade are presented in the following chart with the higher score indicating a preference for learning through tactile and kinesthetic modalities.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	50	54	53	53	51	51	47	47	48	44	41	44

The earlier the grade the more male students prefer to learn in late morning. There is a significant consistent trend to like this time less and less as one gets in higher grades. The scores for each grade are presented in the following chart with the higher score indicating one prefers to learn in the late morning.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	66	55	54	51	49	50	49	49	47	46	46	46

The following LSI areas are significant for the females.

In the area of temperature females preferred it warmer in grade 8 (score of 46) than did females in grade 10 (score 54). However, there seemed to be no pattern across grades.

Females were significantly less persistent in grade 1 (score of 32) than were females in grades 2 through 12 (average score of 50). This may have been related in particular to the females in grade 1 who took the LSI.

Females preferred learning with adults less and less as they progressed from grade 1 through 12. The following chart gives the scores for each grade and the higher score means the greater the desire to learn with adults.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	63	58	55	54	49	42	48	48	47	45	44	43

Females in the upper grades expressed a greater preference for learning through the auditory sense than did females in the lower grades. The following chart gives the scores for each grade and the higher score indicates a greater preference for learning through the auditory sense.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	49	49	47	48	48	50	49	51	50	54	56	56

The higher the grade the less females preferred to learn through the tactile and kinesthetic senses. The following chart indicated the score for each grade.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	53	55	54	53	51	51	47	47	46	44	46	44

There were several grades significantly different for food intake. It seems that females in lower grades and in the intermediate grades want food but females in the other grades do not prefer food as much. The scores for desiring food are in the following chart.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	54	51	47	49	47	49	55	53	51	53	54	49

Females prefer to study in the late morning if they are in the early grades and prefer not to study in the late morning if they are in the higher grades. The scores for each of the grades are in the following chart.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
Score	66	56	54	51	49	49	51	49	49	48	46	46

There were many overall significant differences among different grade levels for males and females. The analysis does not indicate why individuals preferences change in some areas. It could be related to maturation and/or a desire to adapt to the existing educational environments. Additional longitudinal research needs to be conducted to

determine what variable effects the development for certain preferences and what variables contribute to the change of preferences throughout one' s education.

Analysis of Variance Comparing Males With Females
for each of the Areas on the
Learning Style Inventory for each Grade

The significant differences for males and females is summarized for each grade in Table 6.

Insert Table 6 here

A summary of the significant results comparing males to females include the following.

Females desired more light in grades 8 and 11 than did males and males desired more light in grade 2. Males like it cooler in grade 9 and females like it cooler in grade 3. Males like a more informal design than females in grades 5, 6 and 11. Females are more self-motivated in grade 11 and females are more adult-motivated in grades 4 and 6. Females are more teacher-motivated in grades 3, 4, 6 and 12. Males are more unmotivated in grades 4, 5, 7 and 10. Females are more persistent in grades 4, 5, 6, 11 and 12.

Females are more responsible in grades 2, 3, 5 and 10. Females prefer learning alone in grade 5. Females prefer learning with the auditory sense in grades 6, 10 and 12. Males prefer learning by the visual sense in grades 6 and 11. Males prefer learning using the tactile and kinesthetic senses in grades 5, 6 and 8. Males prefer learning in the morning in grade 5. Males prefer learning in the late morning in grade 6. Females prefer to learn in the afternoon in grades 4, 5, 7 and 10. Females prefer learning in the evening in grade 1 and males desire mobility while learning in grades 4, 5 and 9 with females desiring mobility in grade 8. The analyses were calculated based on various groups of students and there are many differences when comparing groups. However, the most important implication is that individuals are different from each other and instruction should be designed to meet the individual' s learning preferences.

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Table 1

Item Loadings After Factors were Rotated

Factor	LSI Subscale(s)	Item (Loading on Factor) Positive Loadings	Negative Loadings
1	19	17(.74)55(.75)85(.73)	18(.69)19(.45)56(.72)84(.70)
2	29,30	23(.59)67(.76)	22(.61)24(.67)30(.36)66(.81) 93(.69)
3	35,36	76(.85)96(.85)	75(.86)95(.84)
4	15,16	14(.81)49(.75)50(.68)	15(.69)
5	1,2	2(.65)33(.71)	1(.59)32(.79)77(.77)
6	5,6	5(.76)37(.80)	6(.78)36(.79)
7	3,4	4(.83)34(.56)	3(.84)35(.69)
8	13,14	47(.41)	13(.70)43(.33)48(.62)80(.73)
9	11	41(.67)42(.64)97(.70)	
10	27,28	64(.68)[illegible].55)91(.64) 99(.68)	
11	35,36	31(.77)[illegible]4(.70)	30(.51)100(.41)
12	31	26(.8[illegible])69(.82)	27(.57)
13	23	57(.35)59(.74)87(.74)	
14	17,18	16(.89)52(.89)	
15	25	61(.72)88(.70)	
16	32	25(.67)68(.76)	
17	17,18	53(.76)98(.76)	
18		54(.62)90(.40)	
19	10	10(.39)44(.64)78(.67)	
20	34	28(.67)63(.33)73(.70)	
21	24	20(.64)57(.51)71(.37)	
22	25	62(.70)92(.67)	
23	33	70(.46)72(.67)	29(.62)
24	12	11(.50)79(.69)	
25	20,21	19(.38)58(.50)86(.65)	
26	15,16	51(.49)82(.69)	
27	9	9(.32)45(.59)	43(.35)81(.32)
28	7,8	7(.55)38(.32)	8(.74)
29		94(.76)	
30	13,14	12(.69)	
31	7,8	40(.60)	39(.45)81(.31)83(.34)
32	26	21(.54)89(.54)	63(.45)

Table 2

Means, Standard Deviation, Reliabilities, and Standard Errors for Males and Females on each of the LSI Areas

Factor No.	LSI Subscales	No.'s	Number of Items	Males N=942, Grades 1-12				Females N=894, Grades 1-12			
				Mean	Sd[1]	r[2]	Se[3]	Mean	Sd[1]	r[2]	Se[3]
5	Sound	1,2	5	3.23	1.66	.76	.73	3.21	1.73	.80	.70
7	Light	3,4	4	2.17	1.46	.73	.66	2.22	1.47	.75	.64
6	Temperature	5,6	4	2.09	1.58	.81	.60	2.14	1.59	.82	.59
28	Design	7,8	3	.62	.79	.35	.52	.47	.70	.31	.47
27	Self-Motivated	9	4	3.06	.64	.06	.54	3.15	.60	.12	.49
19	Adult-Motivated	10	3	2.86	.43	.46	.26	2.89	.36	.33	.24
9	Teacher-Motivated	11	3	2.71	.66	.58	.35	2.81	.53	.57	.28
24	Unmotivated	12	2	1.13	.67	.32	.39	.94	.64	.29	.38
8	Persistent	13,14	6	4.94	1.31	.61	.74	5.23	1.16	.62	.66
4	Responsible	15,16	4	2.50	1.54	.82	.58	2.91	1.43	.82	.52
14	Structure	17,18	2	1.45	.82	.82	.25	1.38	.86	.84	.24
1	Learning Alone	19	7	4.02	1.81	.62	1.04	4.23	1.73	.61	1.00
25	Peer Oriented	20,21,22	3	1.80	1.00	.42	.62	1.90	.99	.40	.62
13	Learning With Adults	23	3	.86	.97	.56	.52	.79	.96	.60	.49
21	Learning Several Ways	24	3	1.75	.92	.26	.64	1.79	.88	.21	.63
22	Auditory	25	2	1.41	.70	.38	.39	1.54	.63	.33	.36
32	Visual	26	3	1.34	.79	.02	.63	1.21	.84	.13	.64
10	Tactile & Kinesthetic	27,28	4	3.05	1.11	.58	.62	2.79	1.28	.66	.65
2	Food Intake	29,30	7	3.51	2.36	.82	.93	3.39	2.39	.83	.91
12	Morning	31	3	1.26	1.19	.72	.51	1.19	1.16	.71	.52
16	Late Morning	32	2	.58	.77	.62	.34	.49	.71	.55	.34
23	Afternoon	33	3	1.49	.92	.24	.65	1.67	.87	.13	.66
20	Evening	34	3	1.65	.69	-.43	.67	1.67	.69	-.45	.68
3	Mobility	35,36	4	2.49	1.71	.90	.46	2.35	1.78	.93	.42

[1]Sd = Standard Deviation

[2]r = Hoyt Reliability

[3]Se = Standard Error

Table 3

Intercorrelation Matrix for Males, N=942, Grades 1-12

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	100	09	-04	-02	-03	00	06	-09	-06	-05	02	14	-11	05	03	-08	01	09	-09	01	00	-01	05	09
2		100	-05	-09	01	-02	04	-09	02	08	01	05	-07	-02	-02	03	05	01	-06	03	-04	03	00	-06
3			100	06	02	-00	00	-01	03	-04	04	-08	09	-02	01	00	05	-01	05	02	-02	01	-04	03
4				100	-11	-14	-11	-01	-10	-07	00	02	-03	01	-01	-01	02	-06	-05	-00	02	-02	-05	03
5					100	21	22	-10	35	16	00	10	-02	-11	00	06	-04	-00	-08	-04	-03	09	03	-09
6						100	29	05	21	09	07	01	07	-03	06	08	05	09	-01	-04	-05	-00	06	06
7							100	-11	15	10	07	01	06	07	12	15	07	12	-04	03	04	09	01	01
8								100	-13	-13	07	-07	07	-06	-08	01	-11	-04	15	-05	-03	-11	04	13
9									100	34	00	15	-05	-14	-01	06	-04	04	-11	-03	-14	09	06	-09
10										100	-06	05	00	-05	-01	06	00	-01	-14	-01	-02	12	-02	-20
11											100	01	04	11	15	06	04	05	-00	02	01	-01	-01	02
12				940 d.f.								100	-53	-18	-14	-07	-09	-06	-15	-06	-09	-03	-04	-08
13				p≤.05-r≤.08									100	12	17	15	04	10	17	05	11	-01	07	10
14				p≤.01-r≤.11										100	48	09	11	16	08	04	16	09	01	-05
15															100	13	10	15	06	09	04	12	01	-05
16																100	04	06	11	-01	00	03	02	04
17																	100	09	01	03	08	04	-26	00
18																		100	02	03	11	08	13	-01
19																			100	04	03	-11	06	19
20																				100	12	02	-01	-01
21																					100	02	01	01
22																						100	05	-55
23																							100	05
24																								100

Table 4

Intercorrelation Matrix for Females, N=894, Grades 1-12

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	100	09	01	00	-05	00	09	-02	-04	-09	02	16	-06	08	07	-03	01	05	-10	-02	00	00	13	00
2		100	-06	04	05	12	08	-06	06	03	05	06	00	00	03	08	02	-02	-04	00	-02	03	-01	-03
3			100	06	-02	02	-04	03	03	03	04	01	01	00	01	00	-02	-02	00	04	-00	-05	02	04
4				100	-01	01	04	-03	-01	-04	02	07	-08	02	01	-03	02	02	-14	02	02	05	-07	-08
5					100	14	14	-18	31	20	-01	05	-05	-08	00	-03	01	04	-11	-01	-07	11	00	-17
6						100	27	-12	21	12	03	01	10	-01	05	02	00	05	-07	-05	03	06	03	-06
7							100	-17	17	03	01	02	04	10	10	-02	-03	12	-07	00	07	05	07	-10
8								100	-10	-16	-03	-06	05	-07	-09	03	-12	-07	18	-04	-05	-13	03	13
9									100	36	-03	14	-03	-18	-03	04	-03	00	-14	-07	-15	18	-01	-13
10										100	-01	06	-07	-01	02	01	04	08	-18	-03	-06	21	-03	-23
11											100	-04	02	10	10	04	05	04	-02	01	07	-01	02	01
12												100	-45	-12	-12	-02	08	-06	-17	02	-05	07	-06	-12
13			892 d.f.										100	04	17	07	-05	03	11	-01	08	-05	07	13
14			p≤.05-r≤.08											100	48	-01	09	19	-00	08	22	10	15	-04
15			p≤.01-r≤.11												100	05	06	10	-06	13	11	06	06	01
16																100	-07	05	10	-08	-05	-04	07	05
17																	100	09	-09	05	12	06	-20	-08
18																		100	01	01	14	05	10	-04
19																			100	-07	01	-15	02	24
20																				100	12	-02	-05	-02
21																					100	05	07	01
22																						100	-01	-53
23																							100	04
24																								100

Table 5

Analysis of Variance for Males and Females within Grades

	Males 11,930 d.f.		Females 11,882 d.f.	
LSI Area	F-value	P≤	F-value	P≤
1	5.46	.0001*	4.26	.0001
2	.99	NS	3.28	.0001
3	2.66	.002	3.11	.0001*
4	1.36	NS	1.83	.05
5	2.24	.011	2.77	.002
6	1.57	NS	4.62	.0001
7	2.31	.009*	4.56	.0001*
8	2.39	.006	2.94	.001
9	3.31	.0001*	8.80	.0001*
10	2.65	.002	4.30	.0001
11	1.38	NS	.84	NS
12	1.77	.05	1.60	NS
13	.57	NS	.57	NS
14	10.35	.0001*	17.17	.0001*
15	.71	NS	1.70	NS
16	1.87	.04	4.99	.0001*
17	2.60	.003	3.80	.0001
18	11.69	.0001*	11.04	.0001*
19	1.49	NS	5.21	.0001*
20	1.47	NS	1.88	.04
21	8.09	.0001*	8.32	.0001*
22	2.23	.01	3.06	.001
23	1.78	.05	1.80	.05
24	1.48	NS	3.8[illegible]	.0001

* Scheffé Post hoc procedures found a significant difference between two or more grades discussed in narrative.

Table 6

Analysis of Variance Comparing Males and Females for each Grade

Grade	LSI Area Number	Male x	Male SD	Female x	Female SD	F-value	P≤
1	23	1.27	.47	2.00	1.00	4.78	.04
2	2	2.18	1.28	1.49	1.08	7.81	.006
2	10	2.65	1.41	3.23	1.11	4.86	.03
3	3	1.75	1.42	2.15	1.49	3.96	.05
3	7	2.71	.65	2.88	.40	5.05	.02
3	10	2.66	1.38	3.08	1.23	5.46	.02
4	5	2.92	.67	3.14	.58	7.92	.005
4	6	2.89	.34	2.96	.23	3.66	.05
4	7	2.76	.60	2.93	.26	7.97	.005
4	8	1.09	.72	.88	.62	5.94	.02
4	9	5.01	1.20	5.36	1.00	6.43	.01
4	22	1.50	.94	1.84	.93	8.52	.004
4	24	2.65	1.69	2.06	1.76	7.16	.008
5	4	.77	.83	.53	.72	5.71	.02
5	5	2.98	.67	3.31	.58	17.05	.0001
5	8	1.22	.64	.85	.63	20.36	.0001
5	9	5.08	1.31	5.54	.93	9.329	.003
5	10	2.51	1.52	3.21	1.25	14.928	.0001
5	12	3.82	1.92	4.34	1.71	4.96	.03
5	18	3.20	.93	2.94	1.13	3.935	.05
5	20	1.26	1.23	.83	1.03	8.51	.004
5	22	1.39	.87	1.79	.93	11.76	.001
5	24	2.40	1.74	1.85	1.86	5.758	.02
6	4	.67	.80	.52	.79	3.757	.05
6	6	2.81	.53	2.93	.25	8.338	.004
6	7	2.73	.62	2.86	.46	5.388	.02
6	9	5.14	1.30	5.45	1.02	6.887	.009
6	16	1.36	.70	1.57	.65	8.859	.003
6	17	1.28	.79	1.07	.86	6.65	.01
6	18	3.16	1.02	2.87	1.27	6.109	.01
6	21	.56	.77	.38	.63	7.506	.006
7	8	1.29	.61	.89	.60	10.624	.002
7	22	1.31	.90	1.72	.95	5.017	.03
8	2	1.94	1.58	2.58	1.41	4.56	.03
8	24	2.19	1.79	2.94	1.59	4.89	.03
9	3	2.41	1.70	1.78	1.76	4.76	.03
9	18	2.81	1.21	2.31	1.36	5.44	.02
10	8	1.31	.55	.93	.63	10.798	.002
10	10	2.06	1.63	2.97	1.57	8.626	.004
10	16	1.50	.62	1.80	.40	9.565	.003
10	22	1.29	.82	1.66	.83	5.17	.024
10	24	3.19	1.44	2.52	1.84	4.20	.04
11	2	2.03	1.42	2.74	1.48	5.116	.025
11	4	.61	.82	.30	.55	4.235	.04
11	6	2.97	.16	2.81	.50	3.884	.05
11	9	4.84	1.22	5.45	1.06	5.978	.02
11	17	1.63	.79	1.26	.87	4.273	.04
12	7	2.28	1.09	2.72	.63	5.33	.02
12	9	5.15	1.03	5.58	.91	4.13	.04
12	16	1.68	.57	1.91	.29	5.51	.02